Counting Calories

Your Tasks (Mark these off as you go)
☐   Review specific heat
☐   Predict which substance has the greatest energy content
☐   Collect your data
☐   Analyze your data
☐   Interpret your results
☐   Receive credit for this lab

☐ Review specific heat

Recall that the **specific heat** (s) of a substance is the amount of heat energy needed to warm 1 g of that substance by 1 °C. The specific heats of several substances are shown in table 1. It can also be thought of as the amount of heat released as 1 g of a substance cools by 1°C. The greater the specific heat for a given substance, the greater the energy required to heat the substance.

Table 1. Specific Heats

Substance	cal/g-°C	J/g-°C
Water	1.000	4.184
Iron	0.107	0.449
Aluminum	0.215	0.901
Ethanol	0.581	2.43

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| Refer to the table above. If you had 100 g of each substance, which substance would require the most energy to heat? How do you know? |
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| If you had a 10 g rubber stopper and a 10 g block of iron, which substance would require the most energy to heat? Explain. |
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| A piece of iron was heated to 100°C and placed in a cup of water at 20°C. Would the final temperature be,

 (a)   Between 20 and 60°C
 (b)   Exactly 60oC
 (c)   Between 60 and 100°C

 Explain. |
| |

☐ Predict which substance has the greatest energy content

The law of conservation of energy states that energy is neither created nor destroyed. For example, when you placed the object in the cup of hot water for example, the temperature of the water decreased and the temperature of the object increased. This is because energy was transferred from the water to the object.

A **calorie** (cal) is unit of energy.

Now consider the following experimental setup which can be used to measure the energy content of different foods.
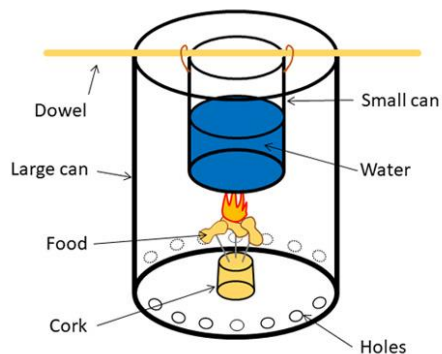
As the food is burned, the energy is transferred to the water and it heats up. Depending on how much is burned and corresponding rise in temperature of the water, we can calculate the energy content of the food.

The energy of content can be determined using the experimental set up shown above.   Predict which of the following substances would have the greatest energy content per gram, which would have the least: Cheetoes, Marshmallows, or Cheese Popcorn. Write a sentence to justify your reasoning

☐ Collect your data

Use the procedure below to collect your data. Record all your data in the data table provided.
1. Obtain a food sample (Cheetoe or Marshmallow)
2. Secure the sample to a paper clip, then secure the paper clip to a cork
3. Measure out about 75 mL of water. Record the volume. Record the temperature.
4. Assemble the can of water above the food.
5. Using a match, light the food sample.
6. Monitor the temperature of the water.
7. After the sample is nearly or completely burned, measure and record the final temperature of the water
8. Allow the food sample to cool to room temperature. Record the final mass of the paper clip, cork, and food sample.
9. Repeat with a marshmallow

Data Table

Food	Mass of food, paper clip, and cork before (g)	Mass of food, paper clip, and cork after (g)	Volume of water (mL)	Temperature of water before (ºC)	Temperature of water after (ºC)

☐ Analyze your data

For each food, calculate the mass of food that burned. Record these values below,

Food	Mass burned (g)

For each food, calculate the temperature change of the water. Record these values below,

Food	Temperature change (ºC)

For each trial, calculate the amount of energy that the water absorbed. Use the following equation. Recall that the density of water is 1 g/mL so the volume of water used is equal to the mass. Also recall that the specific heat of water is $4.184 \frac{J}{g \cdot C}$

Energy = (mass of water) x (specific heat of water) x (temperature change of water)

Food	Energy transferred to water (J)

For each food, calculate the total energy emitted per gram of substance burned.

Energy per gram = (energy transferred to water)/(mass food burned)

Food	Energy per gram

☐ Interpret your results

Answer the following in <u>complete sentences</u>. You must also be mindful of spelling, punctuation and overall writing quality.
What was the purpose of this experiment?
In your own words, summarize what you did in order to accomplish the purpose.
Summarize your findings.   In your summary you must include values you obtained. Indicate which food has more calories per gram? Are your results consistent with your prediction?
Refer to calorie content reported on the package of each food. The calories reported are actually in kilocalories. How do your results compare to those on the bag?
What has more calories per gram (fat or sugar)? Use your results to support your answer.
Identify two sources of error

Error	Major or minor	Effect on reported percentage

☐ Receive Credit for this lab

Each group member must complete and submit their own lab to receive credit